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# TRANSITION REGION AND CORONAL EXPLORER

Contract NAS5-38099  
Progress Report for August 2001

## Introduction and Summary

August was the fourth month of the fourth year of Phase IV (Mission Operations and Data Analysis) of the TRACE program. TRACE is now in its continuous solar viewing period and, as such, collaborative observing with SOHO and other observatories is being emphasized. Unfortunately, this does not yet include HESSI because its launch has been postponed to this fall. The quadrant selector "behaved" rather well throughout most of the month even although its usage was rather heavy; however the frequency of miscommutations increased as the month ended. The data quality in August was poorer than normal, mainly due to mispointings of the LEO-T antenna as a result of using out-of-date ephemeris data. The scientific content of the data continued to be excellent, and was relatively unique in that considerable data was taken with the 284A channel this month. Several papers progressed through various stages of publication. Near the end of the month we were informed of the outcome of the Senior Review panel's evaluation of all operating Space Science Missions and our accompanying budget figures for future years. The funds are less than we proposed, with FY-02 being modestly lower than the current (FY-01) level and the out years being very much lower than that.

## Major Activities During This Reporting Period

Observing this month began with a continuation of JOP-145 wherein TRACE and CDS tracked active regions across the disk to study the evolution of their EUV irradiance. Some nice data sets were obtained in spite of the fact that CDS was unable to participate for a few days when SOHO went into (and out of) an ESR (emergency sun reacquisition) activity. On 6 August, the emphasis of both CDS and TRACE changed to the study sunspot oscillations (JOP-118). Several sunspots were studied over the next two weeks, with one of these (AR#9575) passing through the MDI high resolution field and MDI making one minute observations of it during periods when telemetry was adequate. For a couple of days we then observed prominences in coordination with a group who were observing in H $\alpha$ /beta and HeD3 at the SPO Dunn Tower Telescope. This was followed by a day or two of observing the quiet Sun, first in coordination with CDS and then with SUMER; after which the target again became active regions. Some long runs were made in the hotter (284A) channel, a relatively unusual mode for TRACE. We were rewarded with several quite nice, actually spectacular, eruptions and flares. The observations on the 27<sup>th</sup> and 28<sup>th</sup>

also supported the balloon flight of a Hard X-ray Spectrometer by a group in Japan. On 30 August we began making one full disk mosaic a day for use by observers throughout the world, in place of those routinely provided by EIT who were doing a several day bake-out of their CCD.

Both the spacecraft and instrument functioned nominally during August. There was no reoccurrence of the Safeholds that took place on 10 October 1999 and 14 September 2000. Although the statistics are marginal it does not appear that safeholds are becoming more frequent as the observatory ages. The number of quadrant selector miscommutations was quite small this month although the multi-channel data sets we collected required much more movement of the quadrant shutter than has been the case for quite some time. However, the number increased dramatically during the first few days of September – this will be discussed in the next monthly progress report. TRACE has now been operating on orbit for well over 3 years. During this time it has collected over 6.6 million images and received nearly 135,000 valid commands, plus one invalid command (on 15 September 1998). The shutter moves for each exposure of course, and other mechanisms usually move for the science exposures. The focus mechanism has now made over 13.3 million steps. The life test on a non-flight focus mechanism indicated wear after 14 million (more stressful) steps and although we have seen no degradation in the on-orbit performance we have reduced its usage by taking slightly out of focus 1600Å and white light images when the primary purposes of these images are co-alignment with other observatories and on-board triggering of the flare flag. The degradation in lumogen sensitivity continues with exposures/time but appears to be flattening out, reminiscent of how it behaved during tests at the Stanford Synchrotron Radiation Laboratory prior to launch. Near the center of the CCD it is down to a bit under 50% at 1600Å and about half of that at 1216Å; not so large as to be a major concern but enough to require correcting in some analysis efforts.

As noted in the Introduction, some of the data this month was of very poor quality due to the LEO-T antenna not pointing at the satellite adequately. This happened to WIRE early in the month and the cause was understood and fixed. But fixing things for WIRE made it happen to TRACE. The fundamental problem is that the LEO-T antenna does not rely on the downlink signal to track the spacecraft throughout a contact but rather tracks according to an ephemeris; and for some (software) reason an old ephemeris gets into the system. Manual intervention can, and did, work around this condition but that is people intensive and prone to errors. The root cause is being investigated so that it can be fixed “for good.”

A NASA Senior Review of all (30) Space Science MO&DA programs “to maximize the scientific return from these programs within finite resources” took place in July. We had submitted our proposal to the committee in mid May and in June we provided some additional detail on the personnel planned for the mission. Title, Tarbell, and Fisher then participated in an “oral exam” by the committee on 9 July. Our proposal basically requested a continuation of the level of funding (plus inflation) in FY-03, FY-04, and FY-05 that we have had in FY-01 for the “bare-bones” scenario and a 25% increase for the “optimal” scenario. On 24 August we were informed by NASA headquarters on the result of the review and the TRACE budgets for the next few years. The numbers received include the operations costs at GSFC as well as the funds for LMSAL and our collaborators. If we understand the operations costs properly, they result in a funding level for FY-02 that is 93% of what we had in FY-01 and much, much less than that in the years beyond. There is an opportunity to decrease the GSFC costs and thus increase the 93%

figure for FY-02, and we will be working with GSFC to determine if this is achievable. Major restructuring is required if TRACE is to remain operational during FY-03 and beyond.

Several papers moved through various stages of completion and publication, as noted below. A list of all TRACE publications is on the web. It now contains over 165 published papers and about 35 papers in press.

- a) *A Nanoflare Heating Model for the Quiet Solar Corona* by U. Mitra-Kraev and A. Benz was published as *Astronomy and Astrophysics*, 373, 2001.
- b) *Coronal Electron Acceleration and Relativistic Proton Production during the 14 July 2000 Flare and CME* by K. Klein et al. was published as *Astronomy and Astrophysics*, 373, 2001.
- c) *A Study of Hydrogen Density in Emerging Flux Loops from a Coordinated Transition Region and Coronal Explorer and Canary Islands Observation Campaign* by N. Mein et al. was published as *Ap. J.*, 556, 2001.
- d) *Soft X-Ray Luminosity and Photospheric Magnetic Field in Quiet Sun* by A. Pevtsov and L. Acton was published as *Ap. J.*, 554, 2001.
- e) *On the Nature of the Transition Region from the Chromosphere to the Corona of the Sun* by H. Peter was published as *Astronomy and Astrophysics*, 374, 2001.
- f) *Heating of Coronal Loop Footpoints by Magnetic Reconnection Resulting from Surface Alfvén Waves and Colliding Plasma Flows in Chromospheric Current Sheets* by J. Sakia et al. was published as *Ap. J.*, 556, 2001.
- g) *Transverse Oscillations in Coronal Loops Observed with TRACE: I. An Overview of Events, Movies, and a Discussion of Common Properties and Required Conditions* by C. Schrijver et al. is about to be submitted to *Solar Physics*.
- h) *Transverse Oscillations in Coronal Loops Observed with TRACE: II. Measurements of Geometric and Physical Parameters* by M. Aschwanden et al. is about to be submitted to *Solar Physics*.

### **Other Activities During this Reporting Period**

1. The weekly planning meetings/telecons continued. During these telecons the long-range plan is also updated; see [http://chippewa.nascom.nasa.gov/TRACE/current\\_plan.txt](http://chippewa.nascom.nasa.gov/TRACE/current_plan.txt).
2. We participated in the SOHO SPWG that took place on the 24 August..
3. A TRACE movie showing the planet mercury transiting the Sun was provided for use in a Japanese documentary which will be distributed worldwide.

4. The data reception computer (Cherokee) at the EOF continued to be more robust now that the new disks have been installed.
5. The TRACE image of many loops on the limb that has been in many different magazines will appear in a calendar for 2002 titled *Wonders of the Universe*.
6. To examine the instrument health and see many other items related to operations, go to the web at <http://chippewa.nascom.nasa.gov/TRACE>. To see recent trace data, including pictures and movies “of the day” go to <http://vestige.lmsal.com/TRACE>.

### **Plans for September**

1. Continue to monitor the health and detailed functionality of the instrument.
2. Move forward on many different publications and presentations, as well as on EPO activities. In particular, submit abstracts for presentations at the Fall AGU meeting in San Francisco.
3. Participate in the SPWG that will take place on 28 September.
4. Clarify our funding level for FY-02 and establish appropriate subcontracts with our collaborators.
5. Observations planned for September include:
  - Simple loop systems at the limb in coordination with CDS and SXT (JOP-146)
  - Ellerman Bombs & Severny Moustaches in coordination with MDI and SP (JOP-147)
  - Participate in the Sigmoid target-of-opportunity campaign if it occurs
  - Collaborate with MDI during a 5-day continuous run that begins on 25 September
  - Flares when an appropriate region presents itself and other obligations permit

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